FILE 'USPAT' ENTERED AT 13:30:10 ON 02 JUL 1999

L1 27 POLYGLYCOL (3A) ADIPATE
L2 20602 TETRAMETHYLENE OR POLYTETRAMETHYLENE
L3 0 L1 (P) L2
L4 119 TETRAMETHYLENEGLYCOL OR POLYTETRAMETHYLENEGLOCOL
L5 1 L4 AND 149/CLAS
L6 1 L1 AND L2

1. 3,956,890, May 18, 1976, Solid propellant binder and propellant; Kenneth E. Davis, 60/219; 149/19.4, 19.8, 76, 108.2

US PAT NO: 3,956,890 L6: 1 of 1

BSUM(28) The . . . butylene oxide or mixtures thereof to the polyhydric alkanol base. Typical polyether polyols include polyoxyethylene glycol, polyoxypropylene glycol, polyoxybutylene glycol, **polytetramethylene** glycol, polyoxypropylene adducts of hexane-1,3-diol, . . .

DETD(3)

Ingredients	Weight %
Nitrocellulose.sup.(1)	19.8
Nitroglycerin	49.5
Polyglycol **adipate**.sup.(2)	25.7
Tolylene-2,4-diisocyanate	4.0 . . .

DETD(7)

Ingredients	Weight %
Nitrocellulose.sup.(1)	24.8
Nitroglycerin	41.2
Polyglycol **adipate**.sup.(2)	21.6
Polyoxypropylene glycol.sup.(3)	6.5
Tolylene-2,4-diisocyanate	4.9 . . .

CLMS(4) CLMS(5) CLMS(7) CLMS(12)

L7 21 L1 AND 149/CLAS

1. 5,583,315, Dec. 10, 1996, Ammonium nitrate propellants; Wayne C. Fleming, **149/19.4**, **19.5**

2. 5,468,311, Nov. 21, 1995, Binder system for crosslinked double base propellant; James H. Godsey, et al., **149/19.4**, **19.8**

3. 5,271,778, Dec. 21, 1993, Chlorine-free solid rocket propellant for space boosters; Daniel J. Bradford, et al., **149/19.5**, **19.4**, **19.6**, **20**, **22**

4. 5,074,938, Dec. 24, 1991, Low pressure exponent propellants containing boron; Minn-Shong Chi, **149/21**; 102/285, 291, 292; **149/2**, **19.4**, **19.5**, **22**, **43**, **44**, **60**,

6. 4,670,068, Jun. 2, 1987, Polyfunctional isocyanate crosslinking agents for propellant binders; Minn-Shong Chi, **149/19.4**, **19.7**, **19.8**

7. 4,659,402, Apr. 21, 1987, Cross-linked double base propellant having improved low temperature mechanical properties; Theodore F. Comfort, **149/19.4**, **19.5**, **19.8**

8. 4,477,297, Oct. 16, 1984, Manufacture of gel free nitrocellulose lacquers; Minn-Shong Chi, **149/109.6**, **19.4**, **19.8**, **19.92**, **98**, **100**

10. 4,381,958, May 3, 1983, Triaminoguanidine nitrate-containing propellants; William M. Howard, **149/19.8**, **92**

12. 4,216,039, Aug. 5, 1980, Smokeless propellant compositions having polyester or polybutadiene binder system crosslinked with nitrocellulose; Everette M. Pierce, **149/19.4**, **19.5**, **19.8**, **19.9**, **92**

13. 4,209,351, Jun. 24, 1980, Ambient cured smokeless liner/inhibitor for propellants; Everette M. Pierce, et al., **149/19.1**; 102/290; **149/2**

15. 4,052,943, Oct. 11, 1977, Coating composition and method for improving propellant tear strength; Donald E. Elrick, 102/291, 290; **149/19.4**, **19.5**; 264/3.6

17. 4,018,636, Apr. 19, 1977, Soluble binder for plastic bonded explosives and propellants; Paul L. O'Neill, et al., **149/19.4**, **92**, **93**, **124**

19. 3,954,528, May 4, 1976, Solid gas generating and gun propellant composition containing triaminoguanidine nitrate and synthetic polymer binder; Marguerite S. Chang, et al., **149/19.4**, **19.1**, **19.5**, **19.6**, **19.9**, **19.91**, **92**

20. 3,909,322, Sep. 30, 1975, Solid gas generating and gun propellant compositions containing a nitroaminotetrazole salt; Marguerite S. Chang, et al., **149/19.4**, **19.5**, **19.6**, **19.9**, **19.91**, **36**, **92**

L8 21 L7 AND PLASTICIZER#
L9 7 L7 AND TRIACETIN

1. 4,909,868, Mar. 20, 1990, Extraction and recovery of plasticizers from solid propellants and munitions; William S. Melvin, **149/109.6**; 264/3.1, 3.4

2. 4,462,848, Jul. 31, 1984, Slurry casting method for double base propellants; Donald E. Elrick, **149/19.92**, **19.8**

3. 4,298,411, Nov. 3, 1981, Crosslinked smokeless propellants; James H. Godsey, **149/19.4**, **19.8**, **92**, **94**, **95**, **96**, **98**, **100**

4. 4,080,411, Mar. 21, 1978, Slurry-cast propellant method; Norval F. Stanley, 264/3.4; **149/2**, **97**, **98**

5. 4,038,115, Jul. 26, 1977, Composite modified double-base propellant with filler bonding agent; Henry C. Dehm, **149/19.8**, **7**, **11**, **19.4**, **19.93**, **20**

6. 3,956,890, May 18, 1976, Solid propellant binder and propellant; Kenneth E. Davis, 60/219; **149/19.4**, **19.8**, **76**, **108.2**

7. 3,711,344, Jan. 16, 1973, PROCESSING OF CROSSLINKED NITROCELLULOSE PROPELLANTS; Everette M. Pierce, **149/19.8**, **20**, **38**, **96**, **100**

US PAT NO: 4,909,868 L9: 1 of 7

BSUM(16) Plasticizers . . . triethylene glycol dinitrate (TEGDN), trimethylolethane trinitrate (TMETN), and tetraethylene glycol dinitrate (TEGDN), and the inert or non-explosvie type such as **triacetin**, diethyl phthalate, propyl adipate, and dibutyl sebacate.

BSUM(18) The diisocyanates (crosslinkers) used have included toluene diisocyanate (TDI), hexamethylene diisocyanate (HMDI), and a prepolymer of **polyglycol** **adipate**-toluene diisocyanate (PGA-TDI).

US PAT NO: 4,462,848 L9: 2 of 7

BSUM(4) In . . . modifiers. The casting liquid is typically comprised of an explosive liquid such as nitroglycerin and a nonexplosive plasticizer such as **triacetin** or dibutylphthalate. . . .

BSUM(25) Polyols . . . with dibasic acids such as adipic acid, succinic acid, azelaic acid, sebacic acid, oxadibutyric acid, mixtures thereof, and the like. **Polyglycol** **adipate** is a preferred polyol to be employed with nitrocellulose in the initial slurry of the propellant.

BSUM(26) The . . . The preferred initial slurry contains from about 0.4% to 2.0% nitrocellulose and from about 4% to about 7% polyol, preferably **polyglycol** **adipate**.

DETD(7) Slurries . . . an initial slurry by mixing of ingredients, i.e., a lacquer containing 18-25 cp nitrocellulose and nitroglycerin, additional nitroglycerin, stabilizers, a **polyglycol** **adipate**,

DETD(9) The . . . the 120.degree. F. cure is used primarily to allow curing agent to react with functional hydroxyl groups in nitrocellulose and **polyglycol** **adipate** and thereby solidify the propellant. The composition of each of the resulting propellants is given in **Table IV**.

DETD(10) . . .

4.35	4.35	4.20	5.80	
(12.6% N, 10 sec.)				
Nitrocellulose (18-25 cp)	1.29	1.29	1.29	1.22
Polyglycol **adipate**.sup.(a)	0	5.38	0	0
Polyglycol adipate.sup.(b)	5.46	0	5.51	5.23
Nitroglycerin	39.70	39.70	39.70	38.85
Stabilizer	0.55	0.55	0.55	0.59
Stabilizer	0.94	0.94	0.94. . .	0 0
Pb.sub.2 O.sub.3	0	0.85	0	0

Al.sub.2 O.sub.3 (0.1 micron) 0 0 0.15 0
.sup.(a) **Polyglycol** **adipate**, hydroxyl functionality of about 2.7, molecular weight of about 2400.
.sup.(b) **Polyglycol** **adipate**, hydroxyl functionality of about 2.7, molecular weight of about 4,000. . . .

US PAT NO: 4,298,411 L9: 3 of 7

DETD(2) A . . . stiff paste forms. This paste, and 33.3 parts of a liquid casting solvent mixture comprising 14.5% of the prepolymer of **polyglycol** **adipate**-tolylene 2,4-diisocyanate, 84% nitroglycerin and 2.5% 2-nitrodiphenylamine are added to a Hobart vertical mixer and . . .

DETD(3) . . .
*Ingredient Definitions
NC Nitrocellulose ("Plastisol Nitrocellulose", 12.6%N)
PGA--TDI Prepolymer of **polyglycol** **adipate** and tolylene 2,4-diisocyanate ("Rucoflex Polyester, F-101")
NG Nitroglycerin
DnPA di-n-propyladipate
HMX(B) Cyclotetramethylene tetranitramine (Class B) . . .

DETD(25) Illustrative . . . or non-energetic plasticizers which can be employed include all of the well known non-energetic plasticizers for nitrocellulose such as di-n-propyladipate, **triacetin**,

DETD(27) The . . . employed in this invention are prepolymers of hydroxy terminated polyesters and diisocyanates. The preferred crosslinking agent is the prepolymer of **polyglycol** **adipate** and tolylene 2,4-diisocyanate having a molecular weight range of from about 1000 to about . . .

US PAT NO: 4,080,411 L9: 4 of 7

DETD(5) Casting . . . be mixed with or without one or more low energy plasticizers for nitrocellulose if desired. Illustrative low energy plasticizers are **triacetin**, tripropionin, dibutyl

DETD(14) A . . . flake casting powder having the above formulation with a casting solvent comprised of 46.1 parts of nitroglycerin, 9.7 parts of **polyglycol** **adipate**-tolylene . . .

CLMS(8) 8. The process of claim 5 in which the crosslinking component is the prepolymer of **polyglycol** **adipate**-tolylene diisocyanate.

US PAT NO: 4,038,115 L9: 5 of 7

BSUM(14) The . . . CMDB binder ingredients which include the energetic plasticizer such as nitroglycerin and non-energetic plasticizer such as **triacetin** to varying extents. Reaction of these polyol coated filler particles, however, with an organic isocyanate in the presence of a. . .

DETD(29) . . .
Nitrocellulose (plastisol grade) 18.43%
Nitroglycerin 65.77%
Diisocyanate crosslinker PGA/TDI* 10.54%
Dibutyltin dilaurate 0.005%

m-Dimethoxybenzene 5.28%
***Polyglycol** **adipate**-tolylene diisocyanate prepolymer; molecular weight 1000.

US PAT NO: 3,956,890 L9: 6 of 7

BSUM(24) The . . . oxygen. Representative of the plasticizers are nitroglycerin and triethyleneglycol dinitrate. However, it should be noted that other plasticizers, such as **triacetin**, may be employed in the preparation of the polyurethane composition of this invention for nonpropellant applications. Nitroglycerin is especially useful. . .

DETD(3)
Ingredients Weight %
Nitrocellulose.sup.(1) 19.8
Nitroglycerin 49.5
Polyglycol **adipate**.sup.(2) 25.7 . . .

DETD(7)
Ingredients Weight %
Nitrocellulose.sup.(1) 24.8
Nitroglycerin 41.2
Polyglycol **adipate**.sup.(2) 21.6 . . .

US PAT NO: 3,711,344 L9: 7 of 7

BSUM(12) A prepolymer such as **polyglycol** **adipate**-toluene diisocyanate (PGA-TDI) may be substituted for the nitrocellulose source ingredient and the second portion of toluene diisocyanate

DETD(12) Plasticizers . . . triethylene glycol dinitrate (TEGDN), trimethylol trinitrate (TMETN), and tetraethylene glycol dinitrate (4EGDN), and the inert or non-explosive type such as **triacetin**,

DETD(14) The diisocyanates (crosslinkers) used have included toluene diisocyanate (TDI), hexamethylene diisocyanate (HMDI), and a prepolymer of **polyglycol** **adipate**-toluene

CLMS(3) 3. . . . plasticizer is selected from . . . nitroglycerin, butane trioltrinitrate, diethylene glycol dinitrate, trimethylol ethane trinitrate, tetraethylene glycol dinitrate, **triacetin**,

L10 0 L7 AND NENA
L11 6 NENA AND 149/19.#/CCLS

1. 5,798,481, Aug. 25, 1998, High energy TNAZ, nitrocellulose gun propellant; Thelma Manning, et al., **149/19.8**, **19.6**, 92, 98

2. 5,716,557, Feb. 10, 1998, Method of making high energy explosives and propellants; Bernard Strauss, et al., 264/3.3; 149/18, **19.6**, 19.92; 264/3.1

3. 5,690,868, Nov. 25, 1997, Multi-layer high energy propellants; Bernard Strauss, et al., 264/3.1; **149/19.9**, 19.91, 19.92

5. 5,482,581, Jan. 9, 1996, Low vulnerability propellant plasticizers; Joseph V. Urenovitch, 149/92, **19.8**, 88, 96

6. 5,325,782, Jul. 5, 1994, Insensitive gun propellant; Bernard Strauss, et al., 102/285, 290, 292; **149/19.1**, **19.4**, 19.91

L12 1 L11 AND ADIPATE

1. 5,529,649, Jun. 25, 1996, Insensitive high performance explosive compositions; Gary K. Lund, et al., **149/19.3**, **19.1**, **19.4**, **19.5**, **19.6**, **19.8**, **19.9**, 19.91, 92, 105

US PAT NO: 5,529,649 L12: 1 of 1

BSUM(19) When . . . (nitrocellulose), and mixtures thereof. The binder may also contain 0% to 75% of a plasticizer such as DOA (dioctyladipate or (2-ethylhexyl)**adipate**), IDP (isodecylperlargonate), DOP (dioctylphthalate), DOM (dioctylmaleate), DBP (dibutylphthalate), oleyl nitrile, or mixtures thereof. Energetic plasticizers may also be used, such as BDNPF/BDNPA (bis(2,2-dinitropropyl)acetal/bis(2,2- dinitropropyl)formal), TMETN (trimethylolethanetrinitrate), TEGDN (triethyleneglycoldinitrate), DEGDN (diethyleneglycoldinitrate), NG (nitroglycerine), BTTN (butanetrioltrinitrate), alkyl **NENA**'s (nitratoethylnitramine), or mixtures thereof.

CLMS(18) 18. . . . claim 17, wherein the energetic plasticizer is . . . TMETN (), TEGDN (triethyleneglycoldinitrate), DEGDN (diethyleneglycol-dinitrate), NG (nitroglycerine), BTTN (butanetrioltrinitrate), alkyl **NENA**'s (nitratoethylnitramine), or mixtures thereof.

L13 2757 L1 OR PGA OR POLYGLYCOLADIPATE
L14 29 L13 AND 149/CLAS
L15 8 L14 NOT L7

6. 4,011,114, Mar. 8, 1977, Cross-linked nitrocellulose propellant formulation; John C. Allabashi, **149/19.4**, **19.8**, **19.92**, **20**, **95**, **98**; 264/3.1

L16 6 L15 AND PLASTICIZER#

1. 5,831,339, Nov. 3, 1998, Continuous process for solvent-free manufacture of heat-curable composite pyrotechnic products; Alain Lefumeux, et al., 264/3.3; **149/109.6**; 264/3.1, 3.4

2. 5,500,061, Mar. 19, 1996, Silicon as high performance fuel additive for ammonium nitrate propellant formulations; Larry C. Warren, et al., **149/19.4**, **19.5**, **19.6**, **21**, **39**, **47**

3. 5,240,523, Aug. 31, 1993, Binders for high-energy composition utilizing cis-,cis-1,3,5-tri(isocyanatomethyl)cyclohexane; Rodney L. Willer, **149/19.4**

4. 4,689,097, Aug. 25, 1987, Co-oxidizers in solid crosslinked double base propellants (U); Marvin L. Jones, **149/21**, **85**, **92**, **93**, **98**, **111**

5. 4,531,989, Jul. 30, 1985, Amine bonding agents in polyester binders; Marjorie E. Ducote, et al., **149/19.2**, **19.4**, **19.5**

6. 3,798,090, Mar. 19, 1974, PROCESS FOR PRODUCING CROSS-LINKED PROPELLANTS; John C. Allabashi, **149/19.4**, **18**, **19.8**, **38**, **39**, **44**

BSUM(10) The . . . amounts enhances AN propellant performance to levels approaching conventional high performance propellants. Isp of AN propellants with inert polymer binder (**PGA**), energetic nitramine polymer binder (9DT-NIDA), and energetic glycidyl azide polymer binder (GAP) are illustrated in the single FIGURE of the. . .

BSUM(11) Silicon powder of 2.6 and 9.6 microns of average particles size are evaluated in the inert (**PGA**) polymer configuration (see preferred embodiment Example I). Small test motors (2".times.2" and 2".times.4") cast with propellant containing different amounts (1,. . .

DETD(3) EXAMPLE I: Inert **Polyglycoladipate** (**PGA**) AN Formulation

DETD(4)

Ingredient (abbreviation)	Ingredient and Function	% by Weight
PGA	Inert polymer binder, poly- glycoladipate	6.47
BTTN	Butanetriol trinitrate - **plasticizer**	18.79
TMETN	Trimethylolethane trinitrate - **plasticizer**	12.59
AN	Ammonium nitrate - oxidizer	60.00-54.40
MNA	N-methyl para nitroaniline - stabilizer	0.50
HMDI	Hexamethylene diisocyanate -. . .	

DETD(6) . . .

by (abbreviation)	Ingredient and Function	Weight
9DT-NIDA	Energetic nitramine polymer binder	8.00
BTTN	Butanetriol trinitrate - **plasticizer**	17.86
TMETN	Trimethylolethane trinitrate - **plasticizer**	11.90
AN	Ammonium nitrate - oxidizer	59.60-54.00
MNA	N-methyl para nitroaniline - stabilizer	0.50
TPB	Triphenylbismuth - cure. . .	

DETD(8) . . .

Ingredient and Function		Weight
GAP	Energetic glycidyl azide polymer binder	8.00
BTTN	Butanetriol trinitrate - **plasticizer**	18.42
TMETN	Trimethylolethane trinitrate - **plasticizer**	12.28
AN	Ammonium nitrate - oxidizer	59.60-54.00
MNA	N-methyl para nitroaniline - stabilizer	0.50

HMDI Hexamethylene diisocyanate -. . .

DETD(10) TABLE I
DETD(20) TABLE VII

US PAT NO: 5,240,523 L16: 3 of 6

ABSTRACT: Propellant . . . by curing a hydroxyl-terminated polyether or polyester prepolymer with cis-,cis-1,3,5-tri(isocyanatomethyl) cyclohexane. The propellant compositions also include high-energy particulates and high-energy **plasticizers**. The use of . . .

BSUM(3) High-energy . . . in which is dispersed particulate solids, such as particulate fuel material and/or particulate oxidizers. High-energy compositions typically include a liquid **plasticizer**, such as a nitrate ester **plasticizer**, which

BSUM(4) Of . . . a curative. Examples of relatively non-energetic polyester and polyether prepolymers are polyethylene glycol (PEG), polycaprolactone (PCP), and polydiethylene glycol adipate (**PGA**). An example of an energetic prepolymer is Glycidyl Azide Polymer (GAP).

BSUM(12) In . . . polyester and TIMC as a curative. The propellant composition also contains a particulate fuel material, a particulate oxidizer, and a **plasticizer**. The compositions have enhanced energy relative to similar compositions utilizing N-100 as the curative and . . .

BSUM(16) TIMC . . . invention are propellant formulations in which the elastomeric binder is formed from a polyether or polyester, such as PEG, PCP, **PGA**, GAP, and polyethers. . .

BSUM(18) Substantially the remainder of the high-energy composition consists of matrix material, which includes the elastomeric binder and **plasticizers** therefor. Most polyether-based and polyester-based elastomeric binders are miscible with high-energy nitrate ester **plasticizers**. Nitrate ester **plasticizers** provide substantial energy to the composition, and it is generally desirable to provide as high a **plasticizer** to polymer ratio (Pl/Po) as is consistent with required mechanical properties of the matrix. Typically **plasticizer**-to-polymer ratios range from about 1.5:1 to about 3:1. Nitroester **plasticizers** include, but are not limited to, nitroglycerine (NG); mono-, di-, and triethyleneglycol dinitrate, butanetriol trinitrate (BTTN); and ... (TMETN).

DETD(3) Three **PGA**-based propellants were formulated, one using N-100 as the curing agent and two using TIMC as the curing agent. The propellants were formulated with identical or substantially identical **plasticizer** percentages, Pl/Po ratios, NCO/OH ratios,

DETD(5) TABLE 1

Polymer	**PGA**	**PGA**	**PGA**

DETD(16) The required quantity of binder components, including poly(caprolactone) polymer, BTTN, and TMETN nitrate ester **plasticizers**, MNA, and aluminum are added to a warm (130.degree. F.) mix bowl and stirred for 5 minutes. The mix bowl. . .

CLMS(9) 9. . . . percent of high-energy particulate material, including fuel particulates and oxidizer particulates, balance matrix material including an elastomeric binder and a **plasticizer** therefore, said binder being formed of a hydroxyl-terminated polyether or polyester prepolymer cured with . . . having a **plasticizer** to polymer ratio of between about 1.5:1 and about 3:1.

US PAT NO: 4,689,097 L16: 4 of 6

BSUM(3) High . . . to other oxidizers. Binders consist of mixtures of polymers that can be crosslinked during cure and nitro and nitrate ester **plasticizers**. Typical polymers include but are not limited to poly(ethylene glycol adipate) (**PGA**), polycaprolactone (PCP), and poly(ethylene glycol) (PEG) with hydroxyl functionality between two and three. These polymers are cured with a combination. . . and aliphatic polyisocyanates such as Mobay N-100.RTM. with an isocyanate functionality between 3 and 4. Typical nitro and nitrate ester **plasticizers** include but are not limited to one or more liquids such as a 1/1 mixture of bis-dinitropropyl acetyl (BDNPA) and. . . butane triol trinitrate (BTTN), trimethylol ethane trinitrate (TMETN) and tri(ethylene glycol)dinitrate (TEGDN), with NG and BTTN being the most common **plasticizers** . . .

DETD(4) A typical mix procedure for these propellants is as follows: the nitrocellulose, mixture of **plasticizer**, polymers (such as **PGA**, PCP or PEG) and stabilizers are mixed together at 140.degree. F. for three days to form a lacquer premix. The. . .

US PAT NO: 4,531,989 L16: 5 of 6

BSUM(12) The . . . propellant is comprised of a binder of the polyester polydiethyleneglycoladipate, polycaprolactone which functions as a trifunctional polymer for crosslinking, dioctyladipate **plasticizer**, isophorone diisocyanate curing agent, and triphenylbismuth and maleic anhydride. Solid oxidizers of ammonium perchlorate and ammonium sulfate are employed.

DETD(5) TABLE I

BASELINE COMPOSITION

Polydiethyleneglycoladipate, **PGA** (R-18)	22.79-22.29
Isophorone diisocyanate, IPDI	
Polycaprolactone, PCP-0310	3.72
Dioctyladipate **plasticizer**, DOA	4.00 . . .

DETD(10) Two . . . without bonding agent, e.g., mixes M5.7 and M5.9 of Tables II and III. The binder was comprised of the polymer **PGA**(R18), a polyester, PCP 0310, a trifunctional polymer for crosslinking, DOA as the **plasticizer**, IPDI curing agent and TPB and MA as the cure catalyst system. The solid oxidizers were AP and AS.

US PAT NO: 3,798,090 L16: 6 of 6

ABSTRACT: Chemically . . . diisocyanate during propellant cure. A typical formulation contains nitrocellulose, nitroglycerin, ammonium perchlorate or cyclotrimethylene trinitramine, aluminum and a prepolymer of **polyglycoladipate** and 2,4-tolylene diisocyanate.

BSUM(2) It is known that the mechanical properties of double-base propellants can be improved by using prepolymers of **polyglycoladipate** and tolylene diisocyanate as cross-linking agents for the nitrocellulose. However, unless all of the ingredients are carefully dried and the. . .

BSUM(4) More particularly, the present invention relates to a propellant formulation consisting essentially of nitrocellulose binder, **plasticizer**, solid oxidizer, metal fuel, and a **plasticizer**-

DETD(3) Various propellant compositions were prepared using blocked or nonblocked prepolymer of **polyglycoladipate** and tolylenediisocyanate (**PGA**-TDI) in systems containing 0.05 or 0.10 percent water (all ingredients were carefully dried), 0.15 percent water (ingredients used "as received"),. . . blocked prepolymer was prepared by agitating an equivalent weight of m-nitrophenol with an equivalent weight of the commercial prepolymer of **polyglycoladipate** and tolylenediisocyanate at 80.degree.C. under nitrogen for 4 hours, transferring the reaction mixture to storage containers and maintaining at 80.degree.C.. . . of ethylene glycol and stirring for 20 hours at 80.degree.C. The propellant compositions were prepared as follows: The prepolymer of **polyglycoladipate** and diisocyanate (**PGA**-TDI) or the blocked prepolymer thereof (B-**PGA**-TDI) was dissolved in dry nitroglycerin **plasticizer** (NG) containing 0.67 percent stabilizer 2-nitrodiphenylamine (NDPA) and 0.45 percent of dibutyl tin diacetate catalyst, and . . .

DETD(4) . . .

			Oxidizer				
Ex. No.							
	NC	NG	**PGA**-TDI				
			B-**PGA**-TDI				
				AP	HMX	Al	Catalyst
							H.sub.2 O(%)

DETD(6) In . . . available ingredients without predrying, the use of the blocked diisocyanates of the invention offers the safety feature of desensitizing the **plasticizer**.

DETD(9) Ingredients . . . in mixtures with each other or with one or more of the above inorganic oxidizing salts. Instead of nitroglycerin the **plasticizer** can also be other nitrate esters such as trimethylolethane trinitrate, diethyleneglycol dinitrate, triethyleneglycol dinitrate, 1,2,4-butanetriol trinitrate, bis(dinitropropyl) acetal, bis(dinitropropyl) formal, glycerol monolacetate trinitrate, glycol dinitrate, nitroisobutylglycerol trinitrate, and the like, and other **plasticizers** such as triacetin. . .

L17 154 TETRAMETHYLENE (W) ADIPATE
L18 0 L17 AND 149/CLAS
L19 5 L17 AND (PROPELLANT# OR EXPLOSIVE#)

2. 5,830,528, Nov. 3, 1998, Intercalates and exfoliates formed with hydroxyl-functional; polyhydroxyl-functional; and aromatic compounds; composites materials containing same and methods of modifying rheology therewith; Gary W. Beall, et al., 427/220; 106/483, 484, 487; 501/141, 145, 148

3. 4,036,906, Jul. 19, 1977, Cured polyurethane compositions containing epoxy resins; Anthony F. Finelli, 528/61; 525/454, 528; 528/73

4. 3,926,919, Dec. 16, 1975, Polyurethanes chain-extended with 2,2'-diaminodiphenyldisulfide; Anthony F. Finelli, 528/288; 524/39, 361, 589; 528/45, 64, 290, 354

5. 3,897,400, Jul. 29, 1975, Polyurethane cured with an aromatic monosulfide diamine; Anthony F. Finelli, 528/64; 525/403, 453; 528/48, 52, 74, 75, 76, 80, 83

US PAT NO: 5,830,528 L19: 2 of 5

DETD(31) **Explosives** formed by nitration of pentaerythritol to the tetranitrate using concentrated

nitric acid are generally used as a filling in detonator. . .

DETD(93) Thermoplastic . . . 3,3'-dimethyl-4,4'-diphenylmethane diisocyanate, 3,3'-dimethoxy-4,4'-biphenyl diisocyanate, dianisidine diisocyanate, toluidine diisocyanate, hexamethylene diisocyanate, 4,4'- diisocyanatodiphenylmethane and the like and linear long-chain diols such as poly(**tetramethylene** **adipate**), poly(ethylene adipate), poly(1,4-butylene adipate), poly(ethylene succinate), poly(2,3-butylene succinate), polyether diols and the like;. . .

US PAT NO: 4,036,906 L19: 3 of 5

BSUM(21) Various . . . the polyurethane reaction mixtures are to be used to prepare the cured polyurethanes in confined areas which are subject to **explosive** hazards, nonflammable chlorinated solvents can be used to form nonflammable polyurethane reaction mixtures. . . .

DETD(24) A polyurethane prepolymer of one mole **tetramethylene** **adipate** (1000 m.w.), and two moles tolylene (toluene) diisocyanate was prepared . . .

DETD(38) A polyurethane prepolymer was prepared by reacting 1000 parts of **tetramethylene** **adipate** having a molecular weight of about 1000 and 530 parts of 4,4'-dicyclohexylmethane diisocyanate. The prepolymer was diluted with toluene to. . .

DETD(52) A polyurethane prepolymer was prepared by reacting 50 parts **tetramethylene** **adipate** having a molecular weight of about 1000 and 50 parts **tetramethylene** **adipate** having a molecular weight of about 2000 with about 40 parts of 4,4'-dicyclohexylmethane diisocyanate. The prepolymer was diluted with toluene. . .

US PAT NO: 3,926,919 L19: 4 of 5

BSUM(4) The . . . with some disadvantageous results for some purposes. For example, prepolymers of tolylene diisocyanate and a mixture of propylene adipate and **tetramethylene** **adipate** when cured with either of ODCB or MOCA have been found to yield

BSUM(20) Various . . . the polyurethane reaction mixtures are to be used to prepare the cured polyurethanes in confined areas which are subject to **explosive** hazards, nonflammable chlorinated solvents can be used to form nonflammable polyurethane reaction

DETD(3) A prepolymer was prepared by reacting 100 parts 80-ethylene-20-propylene adipate of 1800 molecular weight, 200 parts **tetramethylene** **adipate** of 2000 molecular weight and an amount of 80/20 mole ratio of 2,4/2,6-tolylene diisocyanate to yield an isocyanate/hydroxyl mole ratio.

L20 84 L2 AND 149/CLAS
L21 23 L20 AND ADIPATE#

6. 4,976,794, Dec. 11, 1990, Thermoplastic elastomer-based low vulnerability ammunition gun propellants; Richard A. Biddle, et al., **149/19.5**, **92**

20. 4,234,364, Nov. 18, 1980, Crosslinked double base propellant binders; Anderson E. Robinson, Jr., **149/19.4**, **19.8**, **20**, **100**

US PAT NO: 4,976,794 L21: 6 of 23

BSUM(14) A . . . Mar. 29, 1988, the teachings of which are incorporated herein by reference. Other specific thermoplastic elastomers include polyethylene succinate/poly diethyleneglycol **adipate** (PES/PEDGA) block polymers and proprietary polymers, such as those sold by DuPont under the trade names LRG 269, and LRG. . .

BSUM(15) The plasticizer, if used, may be non-energetic, e.g., dioctyl phthalate (DOP), dioctyl **adipate** (DOA), Santicizer 8 polyester by Monsanto, butanetriol trinitrate (BTTN), trimethylolethane trinitrate (TMETN), polyglycidal nitrate, or nitroglycerine (NG). Generally, if an. .

DETD(9) . . .
Soft Blocks . . .
poly(ethylene oxide-tetrahydrofuran)
poly(diethylene glycol **adipate**)
polyglycidzyl nitrate
polyglycidyl azide (GAP)
Hard Blocks . . .
poly 1,2-cyclopropanedimethylene isophthalate
poly decamethylene **adipate**
poly decamethylene azelaate . . .
poly **tetramethylene** p-phenylenediacetate
poly trimethylene oxalate

US PAT NO: 4,234,364 L21: 20 of 23

BSUM(14) Polyether . . . invention can be made by the polymerization of unsubstituted cyclic monomers such as ethylene oxide (oxirane), trimethylene oxide (oxetane), and **tetramethylene** oxide (tetrahydrofuran). Copolymers made from mixtures of these are also useful. . . .

DETD(5) Following . . . intrinsic viscosity of about 0.4 dl/gram, a calculated molecular weight of about 14,000, a polyester polyol which is diethylene glycol **adipate** having a hydroxyl functionality of 3, and a diisocyanate crosslinking agent is prepared and tested. . . .

L# LIST 'L1-L21' HAS BEEN SAVED AS 'SAVEALL/L'
U.S. Patent & Trademark Office LOGOFF AT 13:46:18 ON 02 JUL 1999